Perceptual and Motor Skills, 1997, 85, 1376-1378. © Perceptual and Motor Skills 1997

GEOMAGNETIC VARIABLES AND BEHAVIOR: LXXXIII. INCREASED GEOMAGNETIC ACTIVITY AND GROUP AGGRESSION IN CHRONIC LIMBIC EPILEPTIC MALE RATS[1]

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Summary.—In two separate experiments the daily intragroup aggression was inferred from two different measures for male rats with limbic epilepsy ($ns = 4$). There were statistically positive associations of moderate strength (rs about .50) for the frequency with severity of intermale aggression and daily geomagnetic activity. The intense aggression was most evident when the daily aa values for the northern hemisphere, one measure of daily global geomagnetic activity, exceeded 40 nT. Implications for homologous behaviors for human beings, as a species, are suggested.

Weak but complex environmental patterns could encourage aggression when a critical mass (density) of organisms of the same species is achieved (Persinger, 1974). For about a decade we have observed "spontaneous" aggression between rats (housed together 3/cage) with histories of experimentally induced limbic lability (often after days of normal interaction) during the same 24-hr. period as sudden storm commencements and global daily geomagnetic activity exceeding about 40 nT. This study was designed to discern whether this pattern was verifiable quantitatively.

In two separate experiments, two sets of four male Wistar albino rats (Charles River, Quebec), 110 days of age, were injected subcutaneously with 3 mEq/kg of lithium chloride followed 4 hr. later by 30 mg/kg of pilocarpine and 1 hr. later by 25 mg/kg of acepromazine. The rats were housed in long plastic cages within conditions described by Bedard and Persinger (1995). Observations began one week later. In Exp. I, completed between 1 and 22 April, 1994, the number of squeaks (associated with fighting), vibrations (primarily seizures), and ambulation per successive 10-min. intervals between 0100 and 0500 hr. were recorded daily by computer. In Exp. II, completed between 1 February and 5 May, 1996, the presence of small amounts of blood (a more direct inference of aggression) on the sides of the plastic cage, ranked on a 0 to 2 scale, was recorded for 95 successive days.

To minimize risk to the animals the occurrence of blood or indications of extreme aggression were followed immediately after detection (rats were monitored every 6 to 8 hr.) with administration of oral prednisolone (1 mg/cc; Bedard & Persinger, 1995). The protocol also required any rat to be re-

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moved if it received any significant lacerations. These criteria were not reached in this study. Food and water were available *ad libitum* and the 1/4-in. corncob bedding was refreshed weekly.

Values of aa (average antipodal) for the northern hemisphere were obtained from the Geomagnetic Indices Bulletin (National Geophysical Data Center, Solar-Terrestrial Physics Division, 325 Broadway, Boulder, Colorado, 80303). Lag values were calculated for Days 1 through 3. Spearman *rho* and Pearson correlations were completed between measures of aggression and geomagnetic activity for the experiments. All analyses were completed by SPSS software.

For Exp. I, the means and standard deviations were for vibrations 4.5 and 2.2, for squeaks 2.0 and 4.5, for activity 20.2 and 21.8, and for aa values 51.0 and 26.9. The results of Exp. I showed that the numbers of squeaks per daily interval were significantly correlated ($r = .44$; $rho = .73$) with the magnitude of the aa values during the same 24-hr. periods. The discrepancy between the correlation coefficients was due to two outliers, e.g., minimal aggression, periods when the aa values exceeded 80 nT.

The values of *rho* between the vibrations and the aa values of the previous three days were .53, .36, and .10, respectively. Partial correlations, after controlling for ambulation or vibrations did not appreciably change the strength of the association between numbers of squeaks and aa values (partial *r*s about .45). Inspection of the scattergram indicated a conspicuous positive inflection for aggressive behavior at approximately 40 nT.

For Exp. II, there were six nonconsecutive days during the experiment when blood was found on the cage. The mean and *SD* for the aa values for this 95-day period were 22.8 and 12.2, respectively. The association between aa values and the occurrence of blood was significant statistically ($rho = .34$, $r = .54$; $p < .001$). The Spearman *rho*s between this measure of aggression and aa values of the previous three days were .16, .01, and .07. Inspection of the data indicated that the days on which blood was evident occurred when aa values exceeded 40 nT.

The results may be relevant to human behavior. About 70 years ago A. L. Chizevskii (Tchijevsky) had observed that the history of human group conflict, war, displayed a conspicuous periodicity that coincided with and was slightly after maxima of solar activity. Geomagnetic activity is primarily driven by the solar cycle. If there is an intrinsic zeitgeber within the matrix of geomagnetic variations that affects the limbic lability of large *groups* of human beings, then attributions and explanations for war such as political dynamics may be simply spurious. From the perspective of the geopsyche (Persinger & Lafreniere, 1977), as the homogeneity (similarity of neurocognitive patterns due to similar reinforcement histories) of the elements (humans) and the functional connection between the elements (population den-

sity and similar strength of static geomagnetic field) increase, the influence of subtle "trigger patterns" in geomagnetic variations to affect the outcome for group behavior may increase dramatically.

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Accepted November 5, 1997.